

Measure 2: General Purpose Traffic Operations

Monitoring Objectives

The purpose of monitoring general purpose traffic operations is to measure the impacts of tunnel closure on general purpose traffic in the following areas:

- Measure the change in general purpose traffic volumes
- Measure the change in general purpose travel times
- Review traffic operations in the Seattle CBD and make revisions as needed

Methodology

Three data collection efforts were used to evaluate the effect that tunnel closure has had on CBD traffic operations: tube counts; travel time studies; and turning movement counts. Traffic counts using pneumatic tubes were employed to collect traffic volumes at selected locations throughout the Seattle CBD. These automated counting machines yield hourly and daily directional volumes. Travel time studies were also conducted to quantitatively assess changes in travel time for general traffic on several corridor segments before and after the tunnel closure. These corridors included segments along First Avenue, Second Avenue, Fourth Avenue, Fifth Avenue, Stewart Street, Olive Way, Pike Street, Spring Street and Cherry Street. Turning movement counts were also collected at 23 locations. The pre-tunnel closure data was collected in January 2005. The first installment of post tunnel closure data was collected in October, 2005.

Travel time runs were used to estimate changes in general purpose travel time due to the general purpose travel restriction placed on Third Avenue. The “floating car” travel time method was used to collect this data. This method consists of probe cars driven along the routes, where the driver records the time it takes to traverse the route moving within the flow of general traffic. See Figures 5A, 5B, and 5C for a comparison of each of the twelve distinct travel paths, illustrated by time of day.

Figure 6 provides a comparison of pre- and post-tunnel closure PM peak hour volumes and Average Weekday Daily traffic (AWDT).

Figure 6 is a table illustrating changes in vehicle turning movements for the PM peak hour for each of the study locations. The figure highlights turning movement volumes that changed by more than +/-15 percent from pre- to post tunnel conditions, and where the total change in volume was over 100 vehicles per hour. For example, a change in traffic volume from 25 to 50 vehicles an hour is of little significance, but would reflect a 100 percent increase in volume.

Traffic Analysis

With the implementation of the traffic revisions instituted as tunnel closure mitigation, it was anticipated that traffic circulation and travel through town would be impacted. The overall effectiveness of these traffic mitigation strategies could only be proven through actual operating experience and this led to some concern that travel might be difficult in the central business district during this two year closure period.

Based on the first set of post tunnel closure traffic statistics, travel in the morning peak and off-peak periods has been mitigated adequately in terms of sustaining pre-tunnel closure travel times in all but a few cases. During the PM peak period, there are some areas that have experienced increases in travel times.

General Note: Travel time summaries are based on a limited number of observations. A range of 4 to 15 observations does not constitute a statistical sample. However, observations that will be made in future studies should refine and strengthen the value of these reported measures.

The following is a summary of the key findings for general purpose vehicle travel in the Seattle Central Business district following tunnel closure:

Travel Time for General Purpose Traffic:

AM Peak Period (7 - 9 a.m.)

Southbound from Third Avenue and Washington Street to Fourth Avenue and Royal Brougham increased by almost 1 minute.

Olive from Third Avenue to Boren improved by over 1:18 minutes, a possible result of the signal timing changes and transit lane investment.

Pike Street travel time improved by nearly 1 minute.

All other travel times during the a.m. period were less than 1 minute difference, and represent no significant change in operation.

Midday Period (1 -3 p.m.)

Cherry Street travel time increased by 1:40 minutes based on a sample of 6 travel time runs – this will be monitored to see if any action is required. Construction of a high rise in the area may have contributed to these results.

Pike Street improved by nearly 1 minute.

All other travel times during the midday period were less than 1 minute difference, and represent no significant change in operation.

PM Peak Period (4 -6 p.m.)

Stewart Street travel times increased the most –from 3:44 to 6:15 minutes for a total of 2:31 minutes. This is attributed to the increased volumes of both bus and general purpose traffic on Stewart and to additional turning traffic from Stewart to Second Avenue. Several actions have been taken to address this issue. These measures include additional curb use restrictions, transit re-routes, signal timing changes, and the upgrade of signal equipment. This is being closely monitored to determine if additional treatments will be required.

Second Avenue travel time has increased by over 1 minute due to increased congestion between Stewart and Spring Streets.

Fifth Avenue travel times increased from 4:46 to 6:28 minutes, an additional 1:45 minutes.

Spring Street travel time increased by approximately 1 minute.

All other travel times during the p.m. period were less than 1 minute difference, and represent no significant change in operation.

Traffic Volumes

PM Peak Period (4 -6 p.m.)

Ranking based on increased volume

Southbound volume on Second Avenue north of Pine Street increased by 207 vph (+18 percent).

Northbound volume on Sixth Avenue south of Olive Way increased by of 199 vph (+19 percent).

Northbound volume on Sixth Avenue south of University St. increased by 168 vph (+16 percent).

Northbound volume on First Avenue south of Seneca increased by of 98 vph (+14 percent).

Westbound volume on Stewart east of Second Avenue increased by of 97 vph (+16 percent).

Volumes dropped an average of 65 percent on Third Avenue.

AWDT (Average Weekday Daily Traffic)

Third Avenue volumes dropped on average 21 percent of pre-tunnel volumes.

Third Avenue daily volumes drop on average by 1,130 vehicles per day. The range was between 600 to 2,000 vehicles per day depending on location.

Southbound Second Avenue volumes north of Pine St increased the most of all locations. The increase was 3,128 vehicles per day (+22 percent of pre-tunnel AWDT).

Westbound Stewart Street volumes east of Second increased by 1,188 vpd, or +17 percent of pre-tunnel AWDT.

Northbound Sixth Avenue also experienced an increase in daily traffic with up to an additional 2000 daily trips as measured south of Olive Way, or +16 percent increase.

Fourth Avenue experienced an increase in AWDT of +6 percent of pre-tunnel volumes in the northbound one-way section between James and Union Streets.

Turning Movement Counts

Some of the largest increases in turning movement counts were the northbound through movement along Fourth Avenue with over 500 vph in the morning near Cherry Street, and 500 vph northbound in the afternoon near Union Street. This diversion from Third to Fourth Avenues was anticipated, and this illustrates the effect of multiple high rise building garages in the between Cherry and Union Streets area.

Only two of the measured turning movements (actual turns) experienced an increase of more than 100 vph. These are the southbound right turn at Stewart Street and Third Avenue, and the southbound left turn at Spring and Second Avenue. Third and Stewart experience an additional 123 vph during the PM peak hour. Second Avenue and Spring Street had 106 additional turns during the AM peak period.

Some traffic appears to be avoiding Stewart Street and favoring westbound Lenora Street as an alternate route with an additional 97 trips in the a.m. and 160 trips in the PM peak hours.

Figure 5A. General Purpose Travel Time AM Peak (7–9 a.m.)

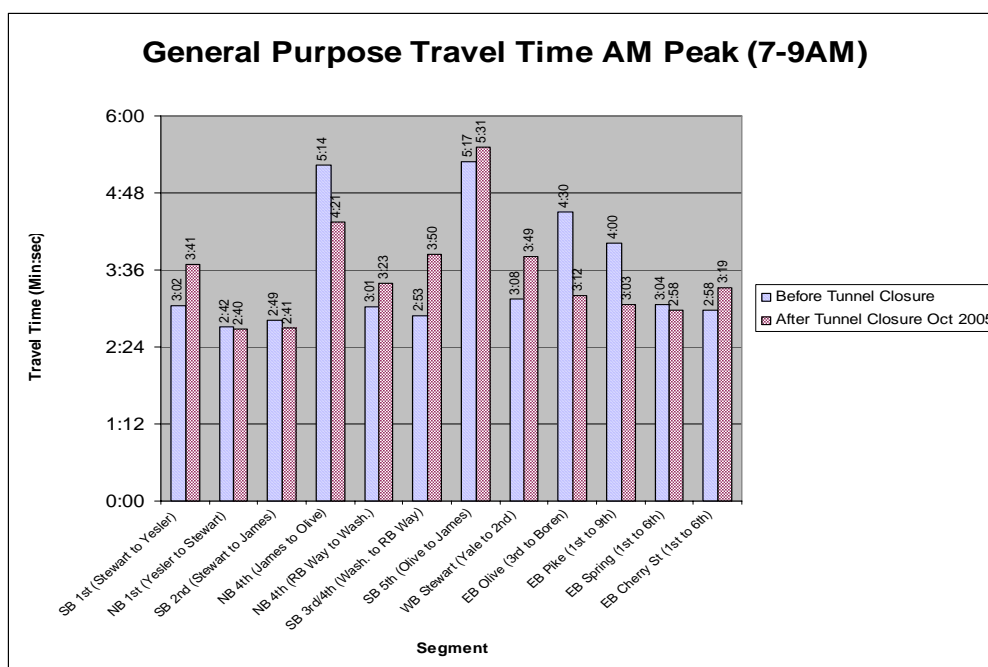


Figure 5B. General Purpose Travel Time PM Peak (4 - 6 p.m.)

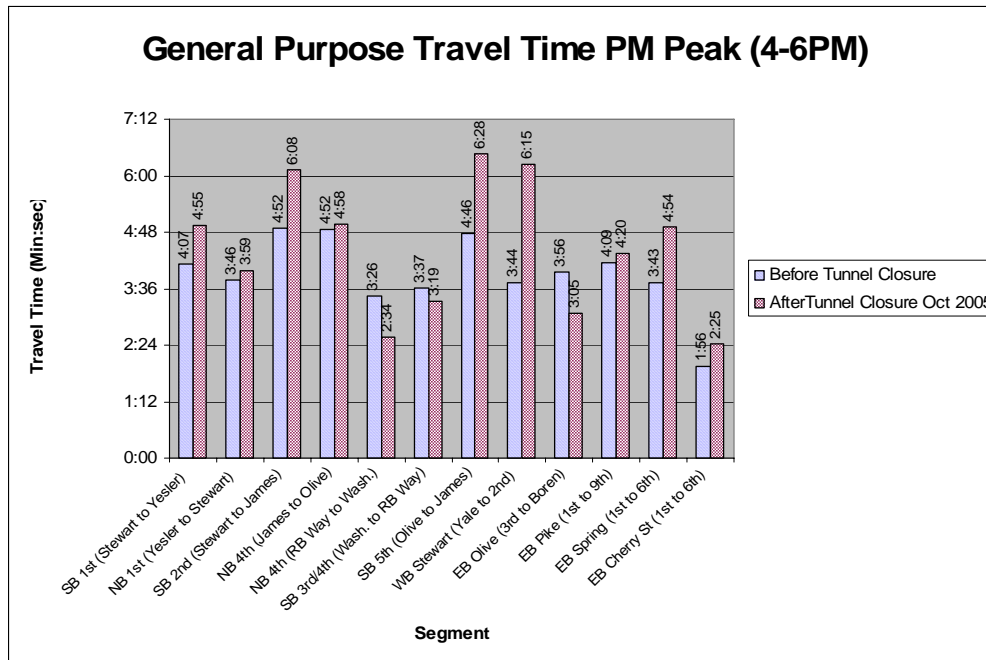


Figure 5C. General Purpose Travel Time Off-Peak (1-3 p.m.)

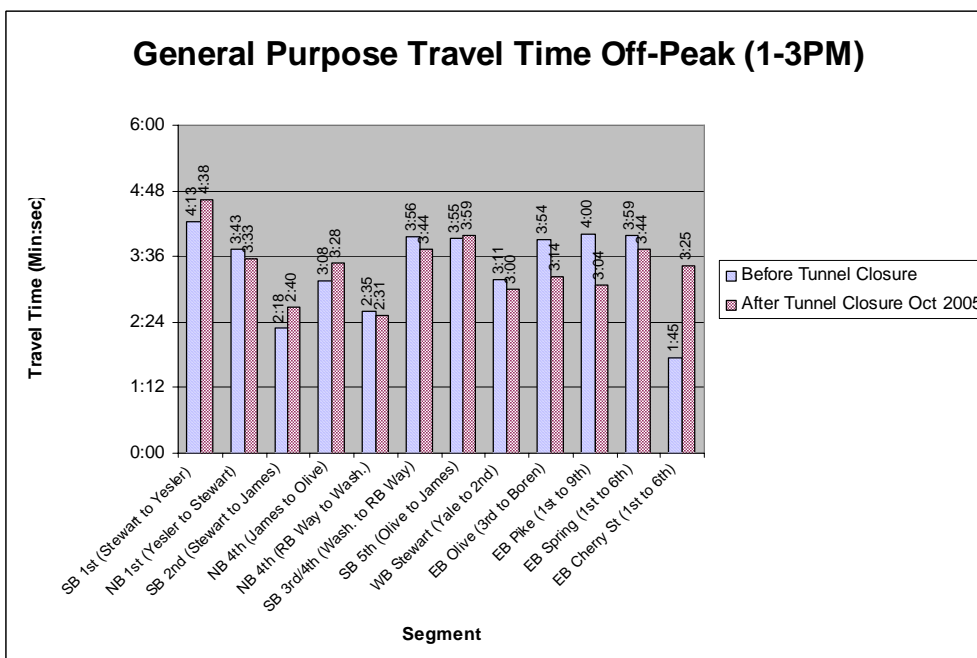


Figure 6. Changes in AWDT Volumes

		Jan-05 Pre-Tunnel Closure		Oct-05 Post Tunnel Closure			
LOCATION	DIR FLOW	PM PK	AWDT	PM PK	AWDT	Percent Change Peak Hour	Percent Change AWDT
1ST AVE, NW/O CHERRY ST	South	610	6,645	436	6,467	-29%	-3%
1ST AVE, NW/O SPRING ST	South	797	10,211	790	10,123	-1%	-1%
2ND AVE, NW/O PIKE ST	South	1,339	16,831	1,232	15,333	-8%	-9%
2ND AVE, NW/O PINE ST	South	1,174	14,441	1,381	17,569	18%	22%
2ND AVE, NW/O VIRGINIA ST	South	1,038	12,429	990	13,013	-5%	5%
3RD AVE, NW/O LENORA ST	South	316	3,749	228	3,131	-28%	-16%
3RD AVE, NW/O PINE ST	South	447	4,684	296	3,612	-34%	-23%
3RD AVE, NW/O STEWART ST	South	356	4,095	260	3,331	-27%	-19%
3RD AVE, NW/O VIRGINIA ST	South	376	4,450	259	3,473	-31%	-22%
3RD AVE, SE/O JAMES ST	South	459	4,286	260	3,132	-43%	-27%
3RD AVE, SE/O UNION ST	South	478	6,297	358	4,282	-25%	-32%
5TH AVE S, N/O S JACKSON ST	South	600	5,626	640	6,497	7%	15%
5TH AVE S, N/O S MAIN ST	South	561	5,590	572	6,171	2%	10%
5TH AVE S, S/O S WELLER ST	South	611	5,094	583	5,670	-5%	11%
WESTERN AVE, NW/O YESLER	South	262	2,301	256	2,304	-2%	0%
1ST AVE, SE/O COLUMBIA ST	North	550	7,430	593	7,968	8%	7%
1ST AVE, SE/O SENECA ST	North	677	7,661	775	8,403	14%	10%
3RD AVE, SE/O BLANCHARD ST	North	630	5,358	338	4,091	-46%	-24%
3RD AVE, SE/O JAMES ST	North	405	4,871	341	4,275	-16%	-12%
3RD AVE, SE/O LENORA ST	North	692	6,189	391	4,829	-44%	-22%
3RD AVE, SE/O STEWART ST	North	692	6,667	396	5,550	-43%	-17%
3RD AVE, SE/O UNION ST	North	515	6,164	359	4,690	-30%	-24%
3RD AVE, SE/O VIRGINIA ST	North	655	5,901	335	4,751	-49%	-19%
4TH AVE S, S/O S JACKSON ST	North	1,218	13,926	1,041	12,068	-15%	-13%
4TH AVE, SE/O CHERRY ST	North	1,784	18,833	1,820	19,000	2%	1%
4TH AVE, SE/O JAMES ST	North	1,523	15,698	1,554	16,456	2%	5%
4TH AVE, SE/O UNION ST	North	1,808	19,236	1,900	20,383	5%	6%
5TH AVE S, S/O S WELLER ST	North	86	1,144	155	1,814	81%	59%
6TH AVE, SE/O OLIVE WAY	North	1,055	12,618	1,254	14,644	19%	16%
6TH AVE, SE/O UNIVERSITY ST	North	1,026	15,102	1,194	16,332	16%	8%
WESTERN AVE, SE/O COLUMBIA	North	208	1,587	211	1,637	1%	3%
CHERRY ST, SW/O 3RD AVE	East	548	5,100	547	5,255	0%	3%
JAMES ST, SW/O 3RD AVE	East	313	2,759	363	3,115	16%	13%
SPRING ST, SW/O 3RD AVE	East	747	7,885	721	7,814	-3%	-1%
UNIVERSITY ST, SW/O 3RD AVE	East	445	5,626	507	6,508	14%	16%
JAMES ST, NE/O 2ND AVE	West	282	4,049	290	4,002	3%	-1%
LENORA ST, NE/O 2ND AVE	West	440	4,463	404	4,620	-8%	4%
PINE ST, NE/O 2ND AVE	West	424	5,330	410	5,602	-3%	5%
STEWART ST, NE/O 2ND AVE	West	626	7,191	723	8,379	16%	17%
STEWART ST, NE/O 4TH AVE	West	785	10,869	819	11,756	4%	8%

AWDT = Average Weekday Traffic count in vehicles per day

PMPK = PM peak hour traffic count in vehicles per hour

Figure 7. Percent change in traffic turning movement volumes between pre- and post-tunnel closure conditions

Intersection	Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
Fifth Avenue Main St	AM				-22%	41%	131%		86%	56%	-60%	71%	
	MD				-9%	30%	-25%		4%	71%	-17%	13%	
	PM				43%	-11%	28%		23%	38%	-13%	90%	
Fourth S Jackson St	AM		-13%	-21%				8%	-9%			11%	-1%
	MD		6%	-30%				0%	5%			34%	4%
	PM		-7%	-21%				-2%	-4%			22%	-13%
Fifth Avenue S Washington	AM				-20%	15%	0%		-65%	-17%	-31%	-51%	
	MD				43%	27%	46%		-6%	4%	0%	15%	
	PM				-18%	-1%	-27%		63%	56%	-53%	-47%	
Fourth James St	AM	84%	13%	24%				60%	3%			-17%	20%
	MD	25%	2%	-7%				140%	11%			-3%	-12%
	PM	60%	13%	-25%				80%	33%			0%	3%
Fourth Cherry St	AM		41%	60%				58%	2%				
	MD		13%	20%				-22%	-1%				
	PM		11%	12%				21%	-7%				
Fourth Union St	AM	15%	14%									3%	22%
	MD	6%	10%									0%	-4%
	PM	29%	40%									-8%	10%
Sixth Avenue University St	AM		-11%	-15%				18%	-25%				14%
	MD		6%	-7%				14%	-8%				-4%
	PM		20%	-6%				25%	-5%				113%
Sixth Avenue Olive Way	AM		2%	0%				-21%	33%				
	MD		-10%	9%				-20%	-2%				
	PM		12%	16%				26%	37%				
Second James St	AM				11%	5%	-14%		-5%	-21%	-24%	-10%	
	MD				18%	3%	15%		31%	33%	6%	18%	
	PM				19%	-7%	-23%		22%	-9%	-6%	36%	
Second Cherry St	AM				23%	12%			1%	0%			
	MD				9%	20%			12%	29%			
	PM				-15%	10%			-14%	-31%			
Second Spring St	AM				47%	20%			5%	21%			
	MD				7%	20%			-3%	7%			
	PM				20%	13%			11%	-2%			
Second University St	AM				28%	19%			1%	6%			
	MD				8%	16%			34%	33%			
	PM				35%	13%			2%	20%			
Third Avenue Pine St	AM	-92%	-52%			-68%	-67%				-59%	7%	0%
	MD	-9%	18%			4%	14%				20%	15%	17%
	PM	-85%	-62%			-64%	7%				-52%	18%	-45%
Third Avenue Stewart St	AM	-85%	-58%	-50%		-82%	107%				-26%	-10%	12%
	MD	-3%	-29%	-44%		-37%	29%				-28%	-28%	-70%
	PM	-90%	-65%	-59%		-81%	181%				-40%	-26%	-66%
Third Avenue Virginia St	AM		-42%	58%	5%	-52%		-7%	13%	16%			
	MD		9%	122%	-4%	2%		-13%	3%	11%			
	PM		-44%	15%	14%	-29%		3%	22%	-18%			
Third Avenue Lenora St	AM	-23%	-52%			-40%	0%				14%	81%	-3%
	MD	8%	-15%			-24%	-13%				-24%	-3%	-9%
	PM	-49%	-55%			-26%	65%				12%	98%	-6%
Second Lenora St	AM					5%	47%				9%	-9%	
	MD					-5%	-27%				3%	17%	
	PM					7%	20%				-2%	22%	
Second Stewart St	AM					14%	21%				33%	10%	
	MD					-6%	-24%				13%	6%	
	PM					-5%	-12%				36%	9%	
Second Pine St	AM					23%	50%				17%	-8%	
	MD					27%	-12%				12%	16%	
	PM					10%	-27%				9%	9%	
First Avenue Spring St	AM		45%	2%	-6%	14%		-10%	-5%	51%			
	MD		-6%	7%	16%	-10%		53%	12%	-6%			
	PM		32%	-30%	-45%	-26%		-11%	-7%	-33%			

Yellow highlighted > 100 vehicles per hour and >15% change

Blue highlighted *Italics*: >100 vehicles per hour and < 15% change

No highlight < 100 vehicles per hour change between pre- and post-tunnel closure

Emergency Vehicle Signal Priority Project

In addition to monitoring general purpose traffic operations, tunnel closure planning included funding for a new Emergency Vehicle Signal Priority Project within the Seattle Central Business District. This project was designed to mitigate potential impacts to the Seattle Fire Department response due to tunnel closure.

"Opticom" units have been installed at forty locations in the Seattle Central Business district to replace the older system of fire preemption. Under the old system, all the programmed signals on a corridor would change to either an all way red or hold in green for the fire response route for three minutes. This three minute period created congestion on the crossing streets to a corridor. This frequently led to motorist frustration and intersections becoming blocked by impatient drivers. The newly installed Opticom system is dynamic, with only the intersections that are within a few hundred feet of the approaching emergency vehicle going into their preemption intervals. This minimizes the number of streets and intersections that have to recover from a preempt. Once the emergency vehicle has passed out of the line of sight, the signal goes into its recovery phasing and resynchronization. This minimizes impacts to the crossing streets and restores the response corridor back into its normal pattern in a timely manner rather than a set interval of three minutes.

Additionally, the project installed cross town preemption that allows for improved response time from the waterfront fire station. No previous hardwired fire preempt system existed for this station.